ERYOPSID REMAINS FROM THE CONEMAUGH GROUP, BRAXTON COUNTY, WEST VIRGINIA

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ABSTRACT

Well-preserved skull, pectoral girdle, limb and vertebral elements of an Eryops specimen have been found in a roadcut near Sutton, Braxton County, West Virginia. The amphibian remains occurred in a green siltstone of unquestionable mid-Conemaugh age. Taxonomic difficulties involving the genus Glaukerpeton Romer and speciation within the genus Eryops are briefly discussed.

INTRODUCTION

The amphibian specimen described in this paper was discovered by the author in July, 1969, in a roadcut between one and 1.1 mile southeast of the southern end of the Elk River bridge at Sutton, Braxton County, West Virginia. Hennen (1917) published a stratigraphic section measured along this highway (now U. S. Route 19) by R. M. Gawthorp. Numerous changes in the path of the highway, uncertainties regarding the aneroid elevations cited in Hennen's description of the section, a strong down section dip component, vagueness of the upper limit of the described section and lack of key or marker beds of distinctive lithology have made reinterpretation of this section difficult. A second visit to the region was made in May, 1971, to confirm the stratigraphic occurrence of the fossil.

STRATIGRAPHIC OCCURRENCE

The 545 foot sequence measured by Gawthorp consists primarily of sandstone, siltstone and variegated shale and clay. The only coal in the section (Brush Creek coal, elevation 950') is no longer exposed. The "Ewing Limestone" can still be seen in the ditch on the west side of the road, a few feet below the 1200 foot contour. Hennen's identification of this limestone with the Ewing Limestone Member is suspect, however, and the nodular limestone probably represents the Rock

Riffle Run Limestone Member associated with the Harlem underclay. Hennen's "Pittsburgh red shale" occurring 15 feet below this freshwater limestone probably represents the Round Knob Shale Member (Pittsburgh redbeds of some authors). In any case, the Round Knob Shale Member lies above the Ewing Limestone Member and not below it.

The only bed higher in the section that can be deemed of any stratigraphic value is a thin, impure freshwater limestone referred to the Elk Lick Limestone Member by Hennen. If this identification is correct, then the overlying redbeds (30 feet in thickness), "massive sandstone" (10 feet in thickness) and "greenish-gray shale" (5 feet in thickness) represent respectively the Morgantown Redbed and Morgantown Sandstone Members. These units are well exposed in the lower part of the extensive roadcut at the top of the hill, elevation of the Elk Lick Limestone Member being approximately 1280 feet.

The amphibian remains were found within one to two feet of the top of the "massive sandstone" unit, elevation approximately 1340 feet, on the east side of the highway, four to five feet above the pavement. Accepting the correlations and elevations of Hennen and Gawthorp, this unit is the Morgantown Sandstone Member of the mid portion of the Conemaugh Group.

Although a few fragmentary eryopsid remains have been described previously from strata of the Conemaugh Group (Case, 1908; Romer, 1952), referrable to either Eryops or Glaukerpeton, the present specimen is better preserved than previously described material; it is, in fact, the finest eryopsid specimen yet discovered in rocks of this age in the Appalachian Basin.

PRELIMINARY DESCRIPTION

Preparation

Only a small portion of the left side of the skull roof and right mandible were exposed in the siltstone matrix. The specimen was carefully prepared, largely with a White air abrasive unit, by Mr. Peter Hoover, Cleveland Natural Science Museum. Additional elements were discovered during the course of the preparation work and these are also noted below.

Skull

(Plate 1, figures 1-3)

The skull roof was badly crushed and considerably distorted, particularly on the right side, making accurate measurements impossible (Plate 1, figure 2). Maximum length of the skull is estimated at 200 mm from muzzle to the tip of the left quadrate. Interorbital width,

the parameter least distorted by crushing, is 45 mm. The specimen is thus considerably smaller than even the holotype of Eryops avinoffi (Romer) and much smaller than E. megacephalus (Cope), E. willistoni (Moodie) and E. grandis (Marsh). The entire skull roof is ornamented by a fine reticulation or pitting. There are about 60-70 pits per square inch, as counted on the right postfrontal at mid orbit.

The left nostril lies about 20 mm from the tip of the muzzle. The distance between the nostril and the orbit (left side) is approximately 77 mm.

The median parietal foramen is obscured by crushing and overriding of the left postparietal. Individual bones of the dermal roof are not always easily delineated, due to the crushed nature of the skull, faintness of the sutures, and difficulty of distinguishing post-mortem breaks from sutures. In some instances the specimen has broken along sutures, though not to such a degree as to indicate that this is necessarily a consequence of immaturity in the individual. The sutures, in so far as they can be discerned, do not differ materially from the pattern described by Sawin (1941) for E. megacephalus.

Unfortunately, the area occupied by the interfrontal is not exposed. The right anterior portion of the skull, including the right premaxillary and nasal, appear to have been shoved posteriorly so that the right nasal completely overlaps the interfrontal. The interparietal and interfrontal suture can be traced easily enough anteriorly to the point where it is overlapped by the dislocated right nasal. In photographs and even upon cursory examination of the specimen, it appears that the median suture continues anteriorly, uninterrupted by an interfrontal element. Close inspection, however, suggests that the right nasal has been pushed some 15 to 20 mm posteriorly and an undetermined distance sinistrally. This dislocation is thought to be sufficient to cover the interfrontal. Even so, belief in the presence of an interfrontal in this specimen is necessarily somewhat subjective, based as it is upon the hypothetical restoration of various dermal elements to their original positions. It can be argued that the right nasal only slightly overlaps the left nasal, that a median internasal suture continues anteriorly and an interfrontal element is absent. Although the nasofrontal margin is readily discerned, there does not seem to be a pronounced indentation that would provide space for the interfrontal; on the other hand, the lateral margin of the nasal is not nearly so straight as that indicated for "Glaukerpeton" avinoffi Romer, in which the interfrontal is presumed to be absent. Removal of the right nasal may be necessary to settle this important point concerning the West Virginia specimen.

Posterior elements of the cranial roof are poorly preserved and incomplete in some instances. The right temporal cannot be satisfactorily located, and the right quadratojugal is badly crushed, shoved dorsally and anteriorly, severely damaging the right squamosal. The right postorbital is almost entirely isolated, having been shoved into the orbit, and there is a wide gap between the right postorbital and the

right postfrontal. The postparietal of the right side and the posterior part of the parietals have not been identified and are apparently entirely, or in large part, missing.

Ventrally, most of the bones of the palate are well preserved. (Plate 1, figure 3) The brain case, though dislocated, is intact, with the right stapes nearly in place. The anterior extension of the parasphenoid and the sphenethmoid are badly crushed, and the sutural surfaces adjacent to the pterygoid are entirely exposed.

The posterior part of the brain case is broken away from the rest of the brain case, and only the lower part of the exoccipitals, and the basioccipital and the foramen magnum can be readily seen. The dorsal part of the exoccipitals and the otic are missing. The fenestra ovalis is present on either side of the ventral surface of the otic, but no trace of the Nvii foramen can be seen anterior to the fenestrae. Nx and Nxii foramina are visible on the left exoccipital, but the rest of that element has been broken away posteriorly.

Anteriorly the sphenethmoid region and the anterior part of the parasphenoid are badly crushed, exposing the vomeronasal nerve canal or first cranial nerve canal. The preorbital flare and anterior end of the sphenethmoid region are poorly preserved.

The prevomerine tooth craters and posterolateral elevations are well displayed though disoriented by crushing. An unusual feature is the presence of a double ectopterygoid tooth and pit on the right side. The left ectopterygoid crater is developed normally.

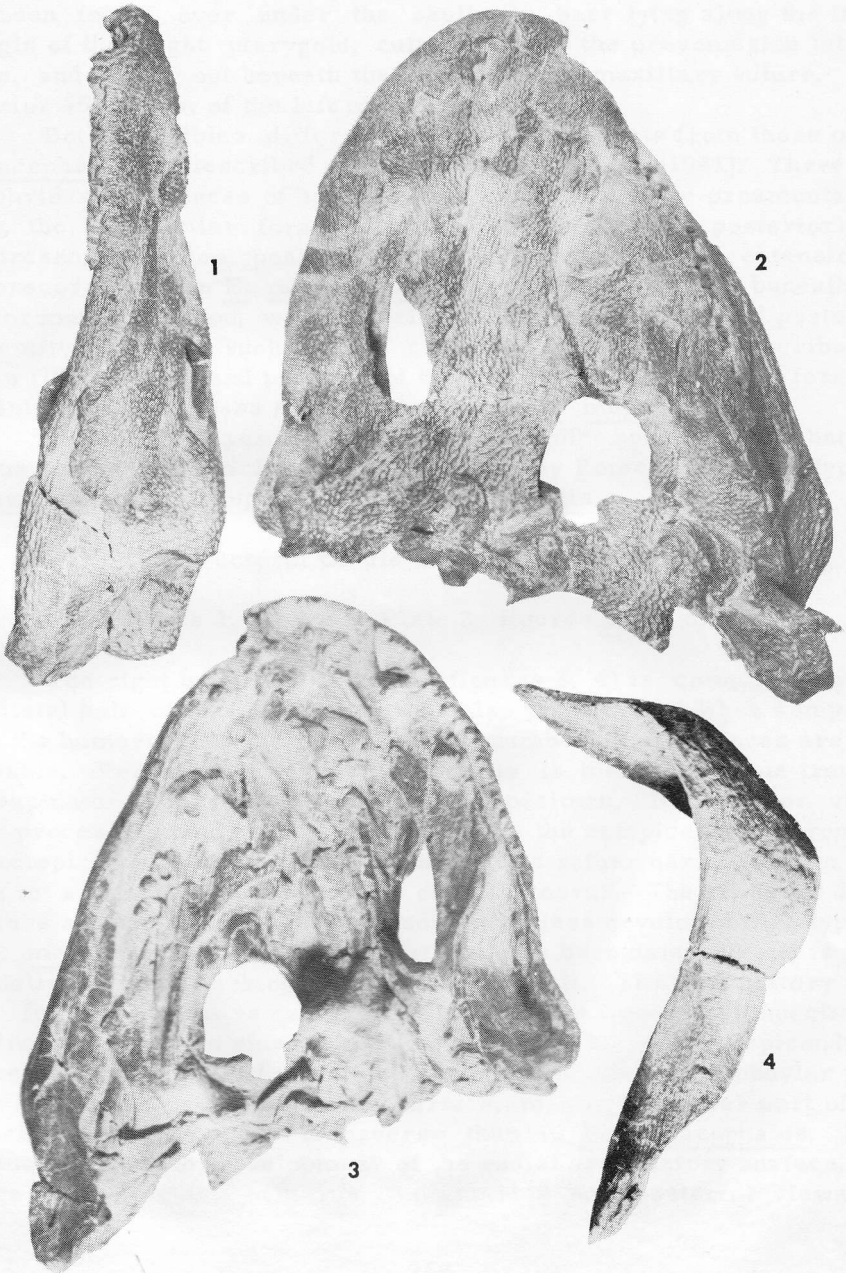
The premaxillaries are not well exposed ventrally, although their common suture can be seen along the margin of the left premaxillary. The number of premaxillary teeth and tooth pits cannot be counted precisely; it is estimated, on the left side, at 12, but may have been 13, as in E. megacephalus.

Maxillary teeth are estimated at 37 on the right and left sides, with about two-thirds of the pits filled. Teeth are largest in the "canine" region of the anterior part of the maxillary, some of these attaining the size of the larger of the premaxillary teeth. Posteriorly, the maxillary teeth decrease rather gradually in size.

The right pterygoid has been crushed posteriorly into the adductor fenestra. The left adductor fenestra is well preserved, but the right is crushed and obscured by the right mandible.

PLATE 1 - Eryops cf. E. avinoffi (Romer) from the Morgantown Sandstone Member, near Sutton, Braxton County, West Virginia. Cleveland Museum of Natural History, no. 11025.

1. Left lateral view of skull, X 0.4.
2. Dorsal view of skull, X 0.4.
3. Ventral view of skull, with left mandible removed, X 0.4.
4. Right clavicle, X 0.9.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Mandibles

(Plate 1, figure 3; Plate 2, figures 1, 2)

The right mandible is preserved nearly in its natural position, though forced upward under the maxilla (Plate 1, figure 3). Though it is virtually complete, none of the teeth are exposed. The left mandible has been folded over under the skull, its base lying along the inner margin of the right pterygoid, cutting across the prevomerine lateral ridge, and jutting out beneath the maxillary-premaxillary suture. The anterior 45-50 mm of the left mandible is missing.

Both mandibles differ only in minor respects from those of E. megacephalus, as described and illustrated by Sawin (1941). There are the obvious differences of smaller size and finer surface ornamentation. Also, the mandibular foramen occurs relatively more posteriorly on the present specimen, posterior to the angular posterior extension of the precoronoid. In E. megacephalus the foramen occurs beneath the precoronoid extension, well anterior to the acutely pointed posterior extremity; at least such is the case with the specimen described by Sawin (1941). Size and position of the mental foramen, dental foramen and inframecklian fossa agree with those of E. megacephalus.

Coronoid sutures are difficult to recognize because of the battery of fine coronoid denticles, a feature noted by Romer in the holotype of E. avinoffi and by Langston (1953) in E. grandis.

Pectoral Girdle and Limb Elements

(Plate 1, figure 4; Plate 2, figures 3, 4, 6, 7)

The right humerus (Plate 2, figures 3, 4) is complete, while the distal half of the left humerus is also preserved. When compared with the humeri of E. megacephalus, a number of differences are observable. Perhaps the most conspicuous is the less oblique trend of the supinator process in the Conemaugh specimen. In posterior view, this process extends only slightly above the ectepicondylar process; the ectepicondylar notch is thus confined to a rather narrow groove best seen in a view of the outer side of the humerus. The latissimi dorsi process and the deltoid crest are somewhat less developed than typical of E. megacephalus though the former has been damaged and is still partially covered, making observation difficult. The articulatory surface for the radius is quite pronounced in the Conemaugh specimen, distinctly bulbous in side view (Plate 2, figure 3). The entepicondylar process does not extend downward much beyond the ectepicondylar process and the radial articulatory surface, making the lower part of the humerus decidely more transverse than in E. megacephalus. As a consequence of the development of the radial articulatory surface, the lower outline of the humerus, in anterior and posterior views, is

distinctly convex rather than concave as in E. megacephalus. On the posterior side, the articulatory surface for the ulna is confined to a small patch on the periphery of the distal edge of the humerus.

Neither Cope's (1888) illustrations of the humerus of E. megacephalus nor Moodie's (1910) drawing of the humerus of E. willistoni permit detailed comparison. A fragmentary, poorly preserved humerus of E. grandis is noted by Langston (1953) but is too poorly preserved for comparison. Miner's (1925) study of the pectoral girdle of E. megacephalus has been relied upon heavily both here and in the following description.

The right scapulocoracoid (Plate 2, figure 6, 7) is very well preserved in the West Virginia specimen, similar in nearly all respects to that of E. megacephalus and E. grandis, except for the much smaller size. It is also relatively shorter than illustrated scapulocoracoids of those two species. No trace of the cleithrum has been recognized in the collection from Sutton. The right clavicle is present (Plate 1, figure 4), slightly crushed ventrally, so that the ventrolateral angulation is nearly 90°. The rather coarse sculpture of the exterior surface is well shown.

A considerable quantity of isolated rib and vertebral elements are in the collection from Sutton. Neither the axis nor atlas has been recognized, and most of the vertebrae appear to represent the cervical and perhaps part of the dorsal section of the spinal column. There are about seven relatively complete neural arches (Plate 2, figure 5) and five readily identifiable intercentra. Numerous small fragments may represent pieces of pleurocentra, though some of these fragments are definitely pieces of neural arch. None of the vertebral elements were found articulated.

TAXONOMIC ASSIGNMENT

The Sutton specimen is so well preserved and relatively complete that all but two previously described rhachitome genera are immediately removed from consideration. In so far as discernible, this Conemaugh specimen agrees in every particular with the well known Permian genus Eryops Cope. As discussed above, there is some

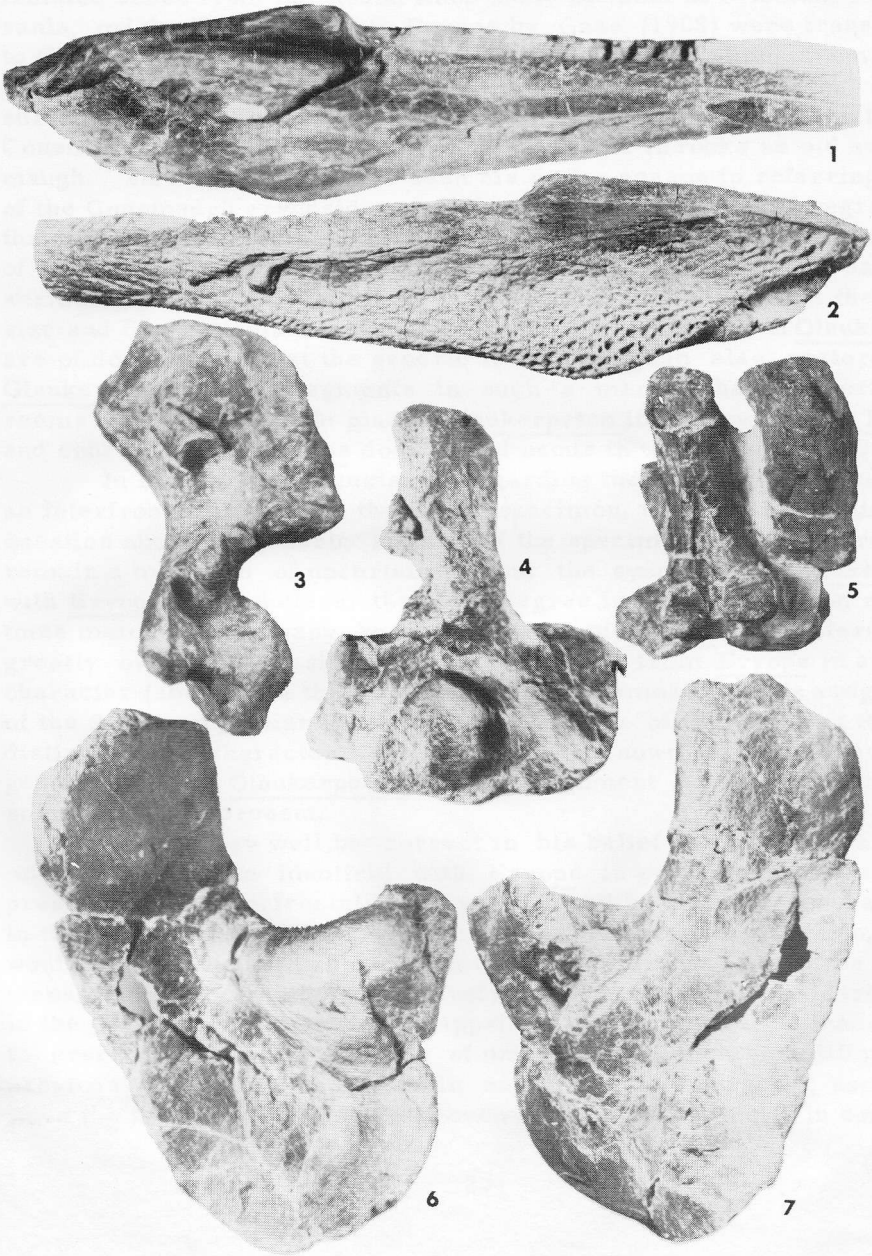
PLATE 2 - Eryops cf. E. avinoffi (Romer) from the Morgantown Sandstone Member, near Sutton, Braxton County, West Virginia. Cleveland Museum of Natural History, no. 11025.

1, 2. Mesial and lateral view of left mandible, X 0.5.

3, 4. Outer and anterior views of the right humerus, X 0.8.

5. Posterior view of cervical neural arch, X 1.1.

6, 7. Inner and outer lateral views of right scapulocoracoid, X 0.7.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question about the nature of the bones of the skull, specifically the presence of an interfrontal element. Uncertainty on this point is especially critical for, while all known Eryops specimens possess an interfrontal, Romer (1952) has erected the genus Glaukerpeton, distinguished from Eryops primarily by its smaller size, finer ornamentation and the absence of an interfrontal. The holotype of Glaukerpeton, G. avinoffi, is a fragmentary skull from a stratigraphic position somewhere in the Pittsburgh Limestone Member, at the very top of the Conemaugh Group, found within the city of Pittsburgh. A variety of small, isolated bones from the Round Knob Shale Member at Pitcairn, Pennsylvania, originally referred to Eryops by Case (1908) were transferred to Glaukerpeton by Romer. This latter material comes from strata slightly lower stratigraphically than the Sutton occurrence. Romer surmised from the dearth of unquestionable Eryops material in the Conemaugh Group that the genus does not occur in rocks as old as Conemaugh. This appears to have been his major reason in referring much of the Conemaugh eryopsid material to his new genus. It is regrettable that only the holotype of Glaukerpeton shows the most diagnostic feature of the genus-- the lack of an interfrontal-- and even this has been seriously questioned. Vaughan (1958) has clearly shown that the small size and fine reticulation cited by Romer in his diagnosis of Glaukerpeton are of doubtful value at the generic level. Vaughan also restores the Glaukerpeton skull fragments in such a manner that an interfrontal seems to be present. He places Glaukerpeton in synonymy with Eryops and concludes that Eryops does indeed occur in the Conemaugh Group.

In light of the uncertainty regarding the presence or absence of an interfrontal element in the Sutton specimen, there must remain some question about the generic identity of the specimen, just as there must remain a modicum of uncertainty about the synonymy of Glaukerpeton with Eryops. Nonetheless, the close degree in which the Sutton rhachitome matches the many known features of Eryops preponderates so greatly over the possibility that it differs from Eryops in a single character (absence of the interfrontal) that the most suitable assignment of the Sutton amphibian is to Eryops. In view of the fact that this one distinguishing character is not certainly known to exist in even the genoholotype of Glaukerpeton, this assignment seems to be the best solution for the present.

Romer may well be correct in his belief that there is a Conemaugh rhachitome identical with Eryops in every respect except the presence of an interfrontal; it is even possible that both genera occur in the Conemaugh. Such parallelism is perhaps not unknown, but it would be very difficult to prove on the basis of only two or three specimens. The very rarity of relatively well preserved eryopsid remains in the Conemaugh Group of the Appalachian Basin makes it inadvisable to erect new taxa on the basis of unique specimens which differ from previously described material in only a single character, especially when the presence or absence of even that one character is in doubt.

At the species level, assignment of the Sutton specimen is less difficult. The small size of the individual and perhaps the relative proportions of the scapulocoracoid and the humerus suggest that the specimen is immature; but it is remarkable that of the half dozen or so Eryops specimens thus far recovered from the upper Pennsylvanian and Dunkard strata of the Appalachian Basin all are considerably below the average size of Eryops megacephalus. It is difficult to believe that all of these are immature specimens, and it is much more probable that a distinct species is represented, one characterized in part by a considerably smaller size and finer ornamentation.

In view of the stratigraphic and geographic proximity of the Sutton occurrence to the holotype of Eryops avinoffi, the two may well be conspecific. The poorly preserved nature of the holotype of E. avinoffi precludes the removal of all doubt on this point, as it has also injected a certain element of doubt at the generic level. Nevertheless, assignment or comparison to E. avinoffi seems the best course in this preliminary study of the Sutton amphibian.

Eryops avinoffi, as interpreted here, differs from other described species of Eryops by virtue of its small size and finer surface ornamentation. The sole exception is E. grandis, which Langston (1953) gives reason to believe is distinctly smaller than typical E. megacephalus. Other minor characteristics noted by Langston include a "dense shagreen" of coronoid denticles, quite like that of E. avinoffi; a mandible relatively more slender than that of E. megacephalus; a thinner, less robust scapulocoracoid. The Sutton specimen herein compared to E. avinoffi differs from E. grandis in being even smaller-- only one-half to two-thirds as large-- with a mandible more like that of E. megacephalus in proportions, and a scapulocoracoid that is stouter, wider, than that of either of the other two species.

As Langston notes, evaluations of such criteria will not be possible until a thorough restudy of all known Eryops material is undertaken. But for the present there is no reason to believe that E. grandis and E. avinoffi are conspecific.

CONCLUSIONS

Preliminary study of a rhachitomous amphibian from the Conemaugh Group near Sutton, Braxton County, West Virginia, suggests that the specimen represents Eryops avinoffi (Romer). The specimen is the best preserved example of Eryops known from the Appalachian Basin, but a critical taxonomic character-- the presence or absence of an interfrontal-- remains uncertain.

It is believed, following Vaughan (1958), that the genus Glaukerpeton Romer is a junior synonym of Eryops. The Sutton specimen thus confirms the presence of Eryops in rocks as old as mid-Conemaugh in age.

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